

Technical Memorandum: Synoptic Evaluation of Drinking Water Constituents of Concern in the Sacramento and San Joaquin River Basins: June 2014

INTRODUCTION

The purpose of this study was to evaluate current water quality within representative agricultural (ag) drains and main stem Sacramento and San Joaquin river sites, against Title 22 Maximum Contaminant Levels (MCLs) and California Toxics Rule (CTR) criteria developed to protect human health. Sampling of the study's 11 sites was conducted over two days (25 June and 30 June 2014), and each designated site was sampled once for this study.

The main question being asked of this study is:

- During a one time snapshot of the irrigation period, do agricultural return flows exceed or cause the main stems of the Sacramento and/or San Joaquin Rivers to exceed human health water quality criteria?

To help answer the main question, the following primary objectives were established:

- Collect representative samples in main agricultural drains discharging into either the Sacramento or San Joaquin Rivers and the rivers themselves;
- Determine spatial distribution of any detectable constituent concentrations of concern; and,
- Identify whether criteria developed to protect human health are exceeded.

This technical memorandum reviews the study design, tabulates resulting data and provides a summary evaluation related to the above question and objectives.

STUDY DESIGN OVERVIEW

Eleven sites were sampled for this study and represented major agricultural (ag) drainages as well as sites in each main river stem upstream and downstream of the ag inflows (Table 1). Figures 1 and 2 are maps of the sampling locations.

Field parameters included temperature, dissolved oxygen (DO), pH, specific conductance (SC) and turbidity. In addition, photos documentation of the water level at each site is summarized in Attachment 1. Samples were also analyzed for all maximum contaminant levels (MCLs) specified in Title 22 of the California Code of Regulations, except for asbestos and radionuclides. In addition, select constituents to protect human health as identified in the California Toxics Rule (CTR) were analyzed, as well as *E. coli* which has been identified as an indicator for potential treatment by the California Department of Public Health. All parameters analyzed and their evaluation criteria are included as Attachment 2.

All aspects of this study, including all samples and field measurements collected, were conducted in accordance with the Procedures Manual for the San Joaquin River Water Quality Monitoring Program (Central Valley Water Board, 2010) which is compliant with the 2008 SWAMP Quality Assurance Program Plan (QAPrP) for the State of California's Surface Water Ambient Monitoring Program (State Water Board, 2008).

Table 1 Sampling Sites

Location	Map Label	Station Code	Sites	Latitude	Longitude
Sacramento River	37	520CBDKLU	Colusa Basin Drain above Knights Landing	38.7992	-121.725
	38	520CRCOOH	Sutter Bypass downstream of Obanion Outfall	39.0258	-121.7272
	39	520YOL001	Sacramento River at Rough and Ready Pumping Plant	38.8621	-121.7927
	40	519SACVER	Sacramento River Below Verona	38.7797	-121.6037
San Joaquin River	30	541MER531	Salt Slough at Lander Avenue	37.24797	-120.85225
	31	541XSSASD	Salt Slough at Sand Dam	37.13664	-120.76194
	32	541MER050	Boundary Drain at SLCC Sampling Station	37.10949	-120.78275
	33	535STC504	San Joaquin River at Crows Landing	37.43323	-121.01597
	34	535STC501	Turlock Irrigation District (TID) Lateral #5	37.46444	-121.03028
	35	541SJC501	San Joaquin River at Airport Way near Vernalis	37.67556	-121.26417
	36	541STC516	Del Puerto Creek at Vineyard Road	37.52139	-121.14861

NOTE: Map Labels match locations depicted in Figures 1 and 2.

Figure 1 Sacramento River Sampling Sites

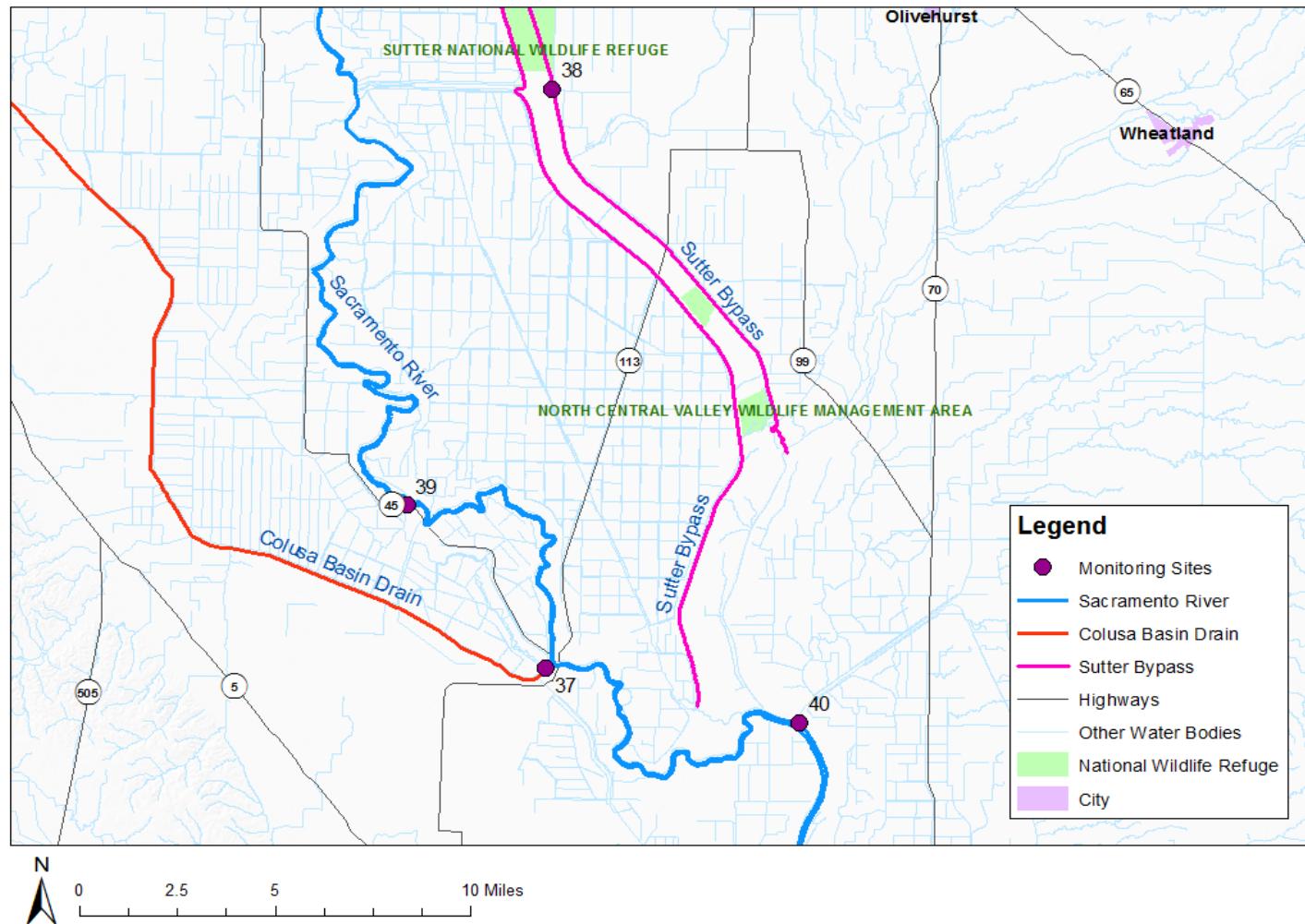
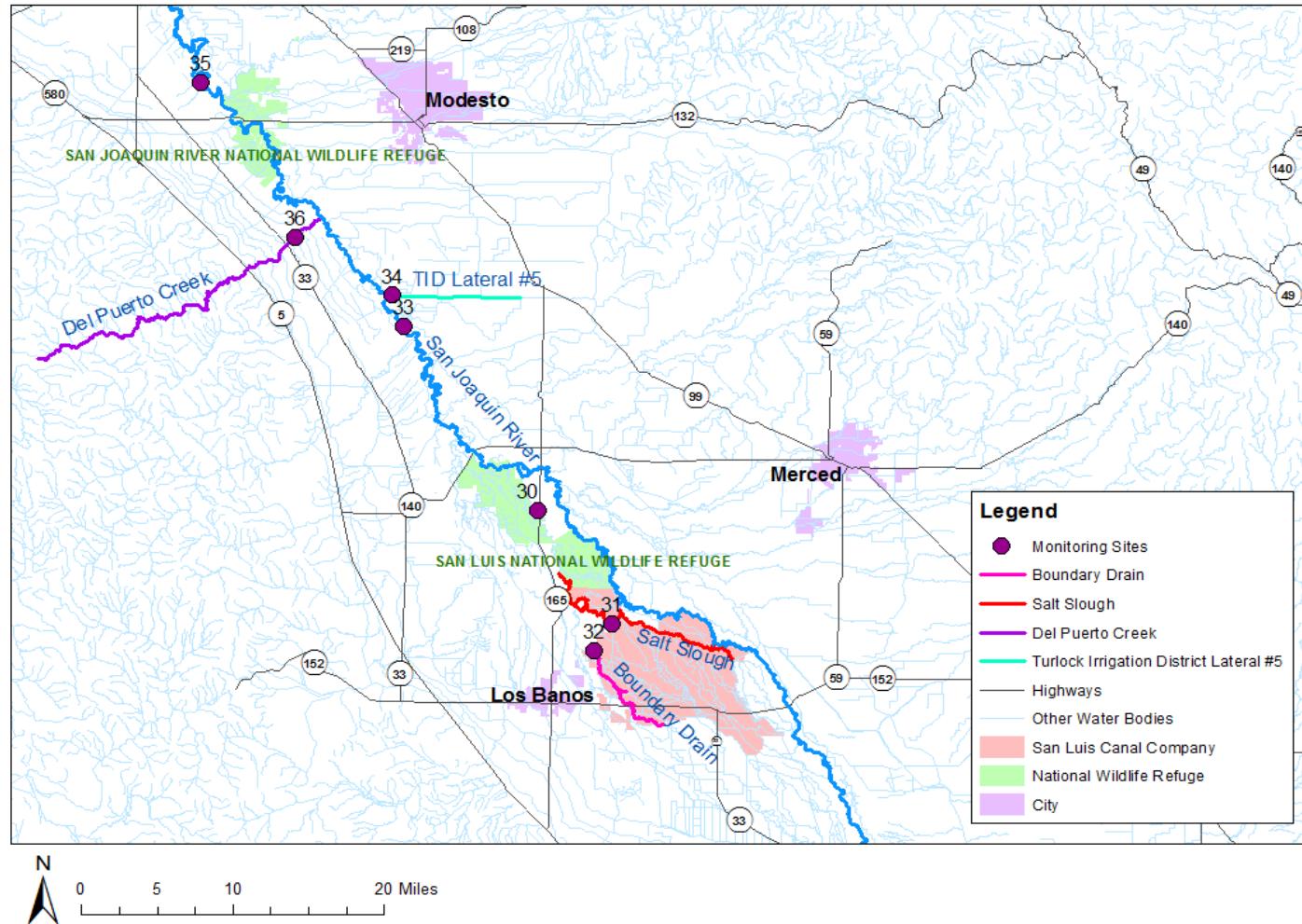


Figure 2 San Joaquin River Sampling Sites



CONDITIONS

Sampling was conducted during the third driest year in California historical records and followed a dry year (2012) and a critically dry year (2013). Currently the state of California is considered to be in an extreme drought. The California Department of Water Resources reports less than 50 percent of normal precipitation from October 2013 to late May 2014 (DWR, 2014), leading to extremely low flows in surface water ways and extensive reuse of available water supplies.

Each sampling site was visually documented with three photographs: downstream of the sampling site; across the channel; and upstream (Attachment 1).

RESULTS

All analytical results that met QA/QC along with reporting limits (RL) and units are reported in Table 2. Analytical methods utilized resulted in constituent reporting limits below respective evaluation criteria. The results table is organized by study areas from left to right: Sacramento River and San Joaquin River Basin. The table is also arranged by constituent from top to bottom: field, bacteria, general chemistry, nutrients, metals, herbicides, pesticides, organics, and dioxins/furans. Shaded results have exceeded the evaluation criteria. Evaluation criteria (Title 22, CTR, etc.) and their sources are listed in Attachment 2.

For all constituents with a result that was below reporting limit or flagged estimated concentration, <RL was used. Reporting limit for some constituents may vary.

Table 2 Summary Results: Sacramento and San Joaquin River Basin

Constituent	Reporting Limit	Unit	Sacramento River						San Joaquin River					
			Colusa Basin Drain above Knights Landing	Sutter Bypass downstream of Oxbow Outfall	Sacramento River at Rough and Ready Pumping Plant	Sacramento River below Verona	Salt Slough at Lander Ave		Salt Slough at Sand Dam	Boundary Drain at SJCC Sampling Station	San Joaquin River at Cows Landing	TID Lateral #5		
Field														
Dissolved Oxygen	NA	mg/L	2.59	5.60	8.69	8.32		5.63	6.64	6.04	12.4	8.28	12.1	7.79
pH	NA	units	7.57	7.52	7.77	8.05		7.44	7.62	7.34	8.08	7.69	8.82	8.65
Specific Conductivity	NA	µS/cm	646	283	133	103		1060	857	858	2260	546	361	1850
Turbidity	NA	ntu	25.2	13.1	6.48	6.02		95.9	57.3	34.8	64.4	13.4	6.94	46.5
Water Temperature	NA	°C	25.1	25.7	22.1	23.6		23.5	24.4	23.9	25.1	26.7	28.4	32.1
Bacteria														
E. coli	1.0 - 2419.6	MPN	22.1	32.3	10.8	9.70		90.8	28.8	108	62.4	517	98.5	40.2
General Chemistry														
Ammonia as Nitrogen	0.1	mg/L	0.1	0.1	0.1	0.1		0.3	0.3	0.1	<0.1	0.2	0.1	0.2
Boron	50 - 100	ug/L	349	<100	48.8	22.8		365	219	290	1620	65.7	124	901
Calcium	0.1-0.2	mg/L	31.4	23.4	10.3	9.30		50.2	42.0	37.4	87.9	21.7	20.8	54.4
Chloride	0.5	mg/L	26	3.7	3.1	2.0		180	110	140	350	54	45	300
Fluoride	0.1	mg/L	0.5	0.1	0.08	0.06		0.2	0.2	0.2	0.3	0.1	<0.1	0.2
Magnesium	0.05-1.0	mg/L	21.8	16.3	4.44	3.47		24.4	17.9	18.0	56.7	6.32	8.89	84.9
Perchlorate	2	ug/L	<2	<2	<2	<2		6	<2	4	<2	<2	<2	<2
Sodium	0.2-0.4	mg/L	73.2	13.4	6.66	3.86		135	97.8	99.4	308	71.0	32.9	198
Sulfate as SO4	0.5	mg/L	88	8.3	3.8	3.3		120	77	89	420	50	28	270
Total Alkalinity	5	mg/L	230	160	62	48		130	130	98	210	98	74	220
Total Dissolved Solids	15	mg/L	387	181	90	64		638	488	479	1390	320	194	1100
Total Hardness	5	mg/L	190	140	52	48		240	190	190	480	88	96	530
Nutrients														
Nitrate as Nitrogen	0.11	mg/L	<0.11	<0.11	<0.11	<0.11		0.57	0.84	0.45	0.67	6.7	0.26	5.3
Nitrite as Nitrogen	0.15	mg/L	<0.15	<0.15	<0.15	<0.15		<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Metals														
Total Aluminum	50	ug/L	1610	1070	360	332		3460	3600	1760	2030	554	263	1560
Total Arsenic	10 - 20	ug/L	<10	<20	<10	<10		<10	<10	<10	<10	<10	<10	<10
Total Iron	20	ug/L	1600	1030	403	386		4060	2970	2000	2220	550	476	1770
Total Lead	5 - 10	ug/L	<5	<10	<5	<5		<5	<5	<5	<5	<5	<5	<5
Total Manganese	10	ug/L	231	123	14.0	27.6		516	192	201	613	66.8	89.6	93.5
Dissolved Aluminum	50	ug/L	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
Dissolved Arsenic	10	ug/L	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10
Dissolved Iron	20	ug/L	<20	22	33	65		<20	23	<20	<20	<20	<20	24
Dissolved Lead	5	ug/L	<5	<5	<5	<5		<5	<5	<5	<5	<5	<5	<5
Total Antimony	10 - 20	ug/L	<10	<20	<10	<10		<10	<10	<10	<10	<10	<10	<10
Total Barium	5	ug/L	82.9	62.1	17.8	14.2		96.2	77.7	61.6	115	54.2	31.6	88.0
Total Beryllium	5 - 10	ug/L	<5	<10	<5	<5		<5	<5	<5	<5	<5	<5	<5
Total Cadmium	5 - 10	ug/L	<5	<10	<5	<5		<5	<5	<5	<5	<5	<5	<5
Total Chromium	5 - 10	ug/L	<5	<10	<5	<5		<5	<5	<5	6	<5	<5	10
Total Chromium IV	1	ug/L	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1
Total Copper	5 - 10	ug/L	<5	<10	<5	<5		<5	<5	<5	5	<5	<5	5.5
Total Nickel	5 - 10	ug/L	6.5	<10	<5	<5		<5	<5	<5	7.3	<5	<5	9.4
Total Selenium	20 - 40	ug/L	<20	<40	<20	<20		<20	<20	<20	<20	<20	<20	<20
Total Silver	5 - 10	ug/L	<5	<10	<5	<5		<5	<5	<5	<5	<5	<5	<5
Total Thallium	20 - 40	ug/L	<20	<40	<20	<20		<20	<20	<20	<20	<20	<20	<20
Total Titanium	50	ug/L	74	62	<50	<50		170	220	85	74	<50	<50	54
Total Zinc	10	ug/L	<10	<20	<10	<10		<10	<10	<10	<10	19	<10	<10
Herbicides														
2,4,5-T	0.5	ug/L	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-TP (Silvex)	0.5	ug/L	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D	0.4	ug/L	<0.4	<0.4	<0.4	<0.4		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
2,4-DB	0.8	ug/L	<0.8	<0.8	<0.8	<0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
3,5-Dichlorobenzoic acid	0.8	ug/L	<0.8	<0.8	<0.8	<0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
4-Nitrophenol	0.6	ug/L	<0.6	<0.6	<0.6	<0.6		<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Aci fluorfen	0.8	ug/L	<0.8	<0.8	<0.8	<0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Bentazon	0.6	ug/L	<0.6	<0.6	<0.6	<0.6		<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Chloramben	0.8	ug/L	<0.8	<0.8	<0.8	<0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Dalapon	0.6	ug/L	<0.6	<0.6	<0.6	<0.6		<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
DCPA	0.4	ug/L	<0.4	<0.4	<0.4	<0.4		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Dicamba	0.4	ug/L	<0.4	<0.4	<0.4	<0.4		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Dichloroprop	0.8	ug/L	<0.8	<0.8	<0.8	<0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Dinoseb	0.4	ug/L	<0.4	<0.4	<0.4	<0.4		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
MCPP	10	ug/L	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10
Pentachlorophenol	0.3	ug/L	<0.3	<0.3	<0.3	<0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Picloram	0.8	ug/L	<0.8	<0.8	<0.8	<0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8

NOTE: Solid shaded boxes indicate an exceedance of evaluation criteria.

Table 2 continued: Summary Results: Sacramento and San Joaquin River Basin

Constituent	Reporting Limit	Unit	Sacramento River					San Joaquin River					
			Colusa Basin Drain above Knights Landing	Sutter Bypass downstream of Obanion Outfall	Sacramento River at Rough and Ready Pumping Plant	Sacramento River below Verona		Salt Slough at Lander Ave	Salt Slough at Sand Dam	Boundary Drain at SLLC Sampling Station	San Joaquin River at Crows Landing	TID Lateral #5	San Joaquin River at Airport Way Near Vernalis
Pesticides													
4,4'-DDD	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDE	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDT	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-Chlordane	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Azinphos-methyl	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
beta-BHC	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bolstar	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Coumaphos	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
delta-BHC	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Demeton	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Demeton-O	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Demeton-S	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Diazinon	0.25	ug/L	<0.25	<0.25	<0.25	<0.25		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Dichlorvos	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Dieldrin	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Disulfoton	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Dursban (Chlorpyrifos)	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan I	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulfate	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Ketone	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
EPN	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ethoprop	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Fensulfothion	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Fenthion	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-BHC (Lindane)	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Gardona (Stirophos)	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Merphos	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Methoxychlor	0.1	ug/L	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mevinphos	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Monocrotophos	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Naled	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Parathion	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Parathion-methyl	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Phorate	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ronnel	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sulfotep	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
TEPP	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tokuthion (Prothifos)	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toxaphene	1	ug/L	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1
Trichloronate	0.2	ug/L	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

NOTE: Solid shaded boxes indicate an exceedance of evaluation criteria.

Table 2 continued: Summary Results: Sacramento and San Joaquin River Basin

Constituent	Reporting Limit	Unit	Sacramento River					San Joaquin River			
			Colusa Basin Drain above Knights Landing	Sutter Bypass downstream of Obanion Outfall	Sacramento River at Rough and Ready Pumping Plant	Sacramento River below Verona		Salt Slough at Lander Ave	Salt Slough at Sand Dam	Boundary Drain at SLLC Sampling Station	San Joaquin River at Crows Landing
Organics											
1,1,1,2-Tetrachloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloropropene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichlorobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichloropropane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromo-3-chloropropane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromoethane (EDB)	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,2-Dichloropropane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-Trichlorophenol	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
2,4-Dichlorophenol	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,4-Dimethylphenol	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,4-Dinitrophenol	10	ug/L	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,6-Dinitrotoluene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Butanone	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-Chloronaphthalene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Chlorophenol	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Chlorotoluene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Hexanone	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-Methylnaphthalene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Methylphenol	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Nitroaniline	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Nitrophenol	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
3-Nitroaniline	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
4,6-Dinitro-2-methylphenol	10	ug/L	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Bromophenyl phenyl ether	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Chloro-3-methylphenol	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Chloroaniline	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Chlorophenyl phenyl ether	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Chlorotoluene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Methyl-2-pentanone	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-Nitroaniline	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Nitrophenol	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5
Acenaphthene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
Acenaphthylene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2
Acetone	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5

NOTE: Solid shaded boxes indicate an exceedance of evaluation criteria.

Table 2 continued: Summary Results: Sacramento and San Joaquin River Basin

Constituent	Reporting Limit	Unit	Sacramento River					San Joaquin River				
			Colusa Basin Drain above Knights Landing	Sutter Bypass downstream of Oxbow Outfall	Sacramento River at Rough and Ready Pumping Plant	Sacramento River below Verona	Salt Slough at Lander Ave	Salt Slough at Sand Dam	Boundary Drain at SLCC Sampling Station	San Joaquin River at Crows Landing	TID Lateral #5	San Joaquin River at Airport Way Near Vernalis
Organics												
Aniline	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Anthracene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aroclor 1016	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor 1221	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor 1232	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor 1242	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor 1248	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor 1254	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor 1260	1	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Azobenzene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo (a) anthracene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo (a) pyrene	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Benzo (b) fluoranthene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo (g,h,i) perylene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo (k) fluoranthene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzoic acid	30	ug/L	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Benzyl alcohol	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-chloroethoxy)methane	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-chloroethyl)ether	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-chloroisopropyl)ether	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-ethylhexyl)phthalate	5	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Butyl benzyl phthalate	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Carbazole	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Carbon disulfide	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon tetrachloride	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroform	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
cis-1,2-Dichloroethene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz (a,h) anthracene	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibenzofuran	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	2	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Di-isopropyl ether	0.5	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

NOTE: Solid shaded boxes indicate an exceedance of evaluation criteria.

Table 2 continued: Summary Results: Sacramento and San Joaquin River Basin

Constituent	Reporting Limit	Unit	Sacramento River						San Joaquin River						
			Colusa Basin Drain above Knights Landing	Sutter Bypass downstream of Obanion Outfall	Sacramento River at Rough and Ready Pumping Plant	Sacramento River below Verona			Salt Slough at Lander Ave			Boundary Drain at SLCC Sampling Station	San Joaquin River at Crows Landing	TID Lateral #5	San Joaquin River at Airport Way Near Vernalis
Organics															
Dimethyl phthalate	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Di-n-butyl phthalate	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Di-n-octyl phthalate	5	ug/L	<5	<5	<5	<5			<5	<5	<5	<5	<5	<5	<5
Ethyl tert-Butyl Ether	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Fluorene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Hexachlorobenzene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Hexachlorobutadiene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorocyclopentadiene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Hexachloroethane	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Indeno (1,2,3-cd) pyrene	5	ug/L	<5	<5	<5	<5			<5	<5	<5	<5	<5	<5	<5
Iodomethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Isopropylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m,p-Xylene	1	ug/L	<1	<1	<1	<1			<1	<1	<1	<1	<1	<1	<1
Methyl tert-Butyl Ether	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene chloride	5	ug/L	<5	<5	<5	<5			<5	<5	<5	<5	<5	<5	<5
Naphthalene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Butylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
N-Nitrosodimethylamine	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
N-Nitrosodi-n-propylamine	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
N-Nitrosodiphenylamine	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
n-Propylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
o-Xylene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	10	ug/L	<10	<10	<10	<10			<10	<10	<10	<10	<10	<10	<10
Phenanthrene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Phenol	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
Pyrene	2	ug/L	<2	<2	<2	<2			<2	<2	<2	<2	<2	<2	<2
sec-Butylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TBA	1	ug/L	<1	<1	<1	<1			<1	<1	<1	<1	<1	<1	<1
Tert-Amyl Methyl Ether	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Trihalomethanes	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorotrifluoroethane	1	ug/L	<1	<1	<1	<1			<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	0.5	ug/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, total	1	ug/L	<1	<1	<1	<1			<1	<1	<1	<1	<1	<1	<1

NOTE: Solid shaded boxes indicate an exceedance of evaluation criteria.

Table 2 continued: Summary Results: Sacramento and San Joaquin River Basin

Constituent	Reporting Limit	Unit	Sacramento River					San Joaquin River						
			Colusa Basin Drain above Knights Landing	Sutter Bypass downstream of Opanion Outfall	Sacramento River at Rough and Ready Pumping Plant	Sacramento River below Verona		Salt Slough at Lander Ave	Salt Slough at Sand Dam	Boundary Drain at SJCC Sampling Station	San Joaquin River at Crows Landing	TID Lateral #5	San Joaquin River at Airport Way Near Vernalis	Del Puerto Creek at Vineyard Road
Dioxins/Furans*														
1,2,3,4,6,7,8-HxCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,4,6,7,8-HpCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,4,7,8,9-HpCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,4,7,8-HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,4,7,8-HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,6,7,8-HxCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,6,7,8-HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,7,8,9-HxCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,7,8,9-HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,7,8,9-HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,7,8-PeCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
1,2,3,7,8-PeCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
2,3,4,6,7,8-HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
2,3,4,7,8-PeCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
2,3,7,8-TCDD	10	pg/l	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10
2,3,7,8-TCDF	10	pg/l	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10
OCDD	100	pg/l	<100	<100	<100	<100		<100	<100	<100	<100	103	<100	281
OCDF	100	pg/l	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100
TEQ		pg/l	0.12	0.01	0.00	0.02		0.02	0.02	0.01	0.02	0.18	0.02	0.02
Total HpCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	75
Total HpCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
Total HxCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
Total HxCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
Total PeCDD	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
Total PeCDF	50	pg/l	<50	<50	<50	<50		<50	<50	<50	<50	<50	<50	<50
Total TCDD	10	pg/l	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10
Total TCDF	10	pg/l	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10

NOTE: Solid shaded boxes indicate an exceedance of evaluation criteria.

DISCUSSION

As documented in Table 2, herbicides, pesticides, organics, and dioxins/furans concentrations were all reported below reporting limit except for two constituents: trihalomethanes (chloroform, bromodichloromethane, and dibromochloromethane) and bis (2-ethylhexyl) phthalate. Some field parameters, one E. coli sample, and a few general chemistry constituents and trace elements had concentrations that exceeded evaluation criteria at certain sites. Turbidity, total aluminum, total iron, and total manganese were found at concentrations exceeding their evaluation criteria (5 NTU, 200 µg/L, 300 µg/L, and 50 µg/L, respectively) at all sites—except for total manganese at the two sites sampled in the Sacramento River. Results are discussed in more detail within individual river basin sections below.

Although dissolved aluminum, iron, and manganese do not have evaluation criteria, they are evaluated against the Secondary MCL of total aluminum, iron, and manganese (300 µg/L, 200 µg/L, and 50 µg/L, respectively). The purpose of analyzing dissolved aluminum, iron, and manganese results is to provide water quality of conventional water that uses treatments such as filtration.

Sacramento River Basin

A total of five constituents had elevated concentrations in the Sacramento River Basin: turbidity, sodium, total aluminum, total iron, and total manganese.

Exceedances for three of the five constituents occurred at all sites, both the agricultural (ag) drains and main stems of the river. Turbidity, total aluminum, and total iron concentrations exceeded their Secondary MCL of 5 NTU, 200 µg/L, and 300 µg/L, respectively. Highest concentrations of turbidity, total aluminum, and total iron ranged up to 25.2 NTU, 1610 µg/L, and 1600 µg/L, respectively at Colusa Basin Drain above Knights Landing.

Although exceedances of turbidity, total aluminum, and total iron occurred at every site, concentrations in ag drains were elevated at higher levels than Sacramento River. Ag drain concentrations of these constituents ranged from 3 to 8 times higher than the evaluation criteria, whereas the Sacramento River had concentrations that were less than double the evaluation criteria. All dissolved aluminum concentrations were below the reporting limit (50 µg/L). Concentrations of dissolved iron ranged from less than 20 µg/L to 65 µg/L with the highest concentrations in the main stem Sacramento River.

Exceedances of total aluminum, iron, and manganese seem to correlate to high reservoir outflow from Shasta and Oroville reservoirs (Sacramento River Watershed Sanitary Survey 2010 Update). Flows from these reservoirs are diverted and utilized for irrigation of ag land.

Conversely, only the ag drain sites showed elevated levels of sodium and total manganese. Sodium exceeded the USEPA Drinking Water Advisory¹ of 20 mg/L at Colusa Basin Drain above Knights Landing with a concentration of 73.2 mg/L. Total manganese exceeded Secondary MCL of 50 µg/L at both Colusa Basin Drain above Knights Landing and Sutter Bypass downstream of Obanion Outfall site. Highest total manganese concentration reached 231 µg/L.

¹ USEPA Drinking Water Advisory for persons on restricted sodium diet.

San Joaquin River Basin

A total of fifteen constituents had elevated concentrations in the San Joaquin River Basin: pH, specific conductance (SC), turbidity, *E. coli*, boron, chloride, perchlorate, sodium, sulfate, total dissolved solids (TDS), total aluminum, total iron, total manganese, trihalomethanes, and bis (2-ethylhexyl) phthalate.

Exceedances for five of the fifteen constituents occurred at all sites. Turbidity, sodium, total aluminum, total iron, and total manganese exceeded their evaluation criteria of 5 NTU, 200 µg/L, and 300 µg/L, 50 µg/L, respectively. Highest concentrations of turbidity, sodium, total aluminum, total iron, and total manganese ranged up to 95.9 NTU at Salt Slough at Lander Avenue, 308 mg/L at San Joaquin River at Crows Landing, 3600 µg/L at Salt Slough at Sand Dam, 4060 µg/L Salt Slough at Lander Avenue, and 613 µg/L at San Joaquin River at Crows Landing, respectively.

Generally, concentration levels of turbidity, sodium, total aluminum, total iron, and total manganese increased as water moved downstream from Boundary Drain at SLCC Sampling Station to San Joaquin River at Crows Landing. Eastside flows from Turlock Irrigation District (TID) Lateral #5 tended to have lower concentrations than Crows Landing while westside flows from Del Puerto Creek at Vineyard Road had higher concentrations. Concentrations tended to be lowest at the furthest downstream site (San Joaquin River at Airport Way near Vernalis). All dissolved aluminum concentrations were below the reporting limit (50 µg/L). Dissolved iron was only detected above the 20 µg/L reporting limit in two sites in the San Joaquin River Basin (at 23 µg/L and 24 µg/L).

The pH value, SC, chloride, sulfate, TDS, and bis (2-ethylhexyl) phthalate exceeded their evaluation criteria of 8.0, 900 µhos/cm, 250 mg/L, 250 mg/L, 500 mg/L, and 1.8 µg/L, respectively, in the San Joaquin River Basin, though not in all sites. These exceedances occurred mostly in San Joaquin River at Crows Landing, Del Puerto Creek at Vineyard Road and/or Salt Slough at Lander Avenue and had concentrations that were less than double the evaluation criteria.

Perchlorate, chloroform, bromodichloromethane, dibromochloromethane, and *E. coli* exceeded their criteria of 6 µg/L, 1.8 µg/L², 0.56 µg/L, 0.41 µg/L, and 200 MPN/100mL, respectively only in San Joaquin River Basin agricultural drains. Perchlorate was exceeded at Salt Slough with a concentration of 6.31 µg/L, just above the evaluation criteria. *E. coli* was exceeded at TID Lateral #5 with a concentration of 517 MPN/100mL. Along with *E. coli*, elevated concentrations of trihalomethanes were also found at TID Lateral #5. According to an Administrative Civil Liability (ACL) Complaint that was filed by the Central Valley Regional Water Quality Control Board on March 7, 2014, the City of Turlock had issues with elevated concentrations of trihalomethanes in their effluent which eventually makes its way into TID Lateral #5. It is not clear whether the effluent discharges influences water quality during this sampling period.

Boron exceeded its criteria of 1000 µg/L only at the San Joaquin River at Crows Landing with a concentration of 1620 µg/L.

² Cal/EPA Cancer Potency Factor as a drinking water level assuming 70 kg body weight and 2 liters per day drinking water consumption.

SUMMARY/CONCLUSION

This study was designed to determine if agricultural return flows exceed or cause the main stems of the Sacramento and/or San Joaquin Rivers to exceed Maximum Contaminant Levels (MCLs) specified in provisions of Title 22 of the California Code of Regulations, California Toxics Rule (CTR) criteria, California Public Health Goals (PHG), USEPA Drinking Water Advisory, or Odor threshold criteria during the irrigation period.

When analyzing the water quality results collected from the Sacramento and San Joaquin River Basin against the evaluation criteria listed in Attachment 2, most constituents (total 258 out of 275) were below the evaluation criteria and/or reporting limit. In general, for the constituents consistently identified at concentrations above the evaluation criteria (turbidity, total aluminum, total iron and total manganese), the furthest downstream main stem river sites reported the lowest concentration with agricultural (ag) drainage from the western side of each basin containing the highest concentrations. Dissolved concentrations for aluminum and iron were below evaluation criteria.

Concentrations of specific conductance (SC) in San Joaquin Basin sites ranged from 361 $\mu\text{mhos}/\text{cm}$ to 2260 $\mu\text{mhos}/\text{cm}$ as compared to Sacramento Basin sites which ranged from 103 $\mu\text{mhos}/\text{cm}$ to 646 $\mu\text{mhos}/\text{cm}$. The San Joaquin River Basin also had more constituents that exceeded evaluation criteria than Sacramento River Basin. For those constituents that were elevated at both the ag drain and river stem sites, concentrations were much higher in the ag drains than the main river stem sites.

Total manganese and sodium were elevated at every site in San Joaquin River Basin, but only elevated at ag drains in the Sacramento River Basin. Concentrations of SC in San Joaquin are a lot higher than Sacramento. The different geology in the San Joaquin River Basin that lead to a sodium-sulfate dominated system rather than a sodium chloride system in the Sacramento River Basin may explain the difference in SC between the two river basins.

The collected samples were representative of the main agricultural drains and the Sacramento and San Joaquin Rivers. Only 17 criteria developed to protect human health were exceeded. Some constituents with elevated concentrations appear to be linked to geology of the river basins (e.g., sodium and SC), while others have been correlated to high reservoir outflow from Shasta and Oroville reservoirs (e.g., total aluminum, iron and manganese) (Sacramento River Watershed Sanitary Survey 2010 Update). During this one time synoptic sampling event, it does not appear that inflows from the agricultural drains caused the analyzed constituents to exceed evaluation criteria.

REFERENCES

1. California Department of Water Resources (DWR). 2014. Drought Conditions. Available at:
<http://www.water.ca.gov/waterconditions/waterconditions.cfm>
2. California Regional Water Quality Control Board, Central Valley Region, Central Valley Water Board. 2008. SWAMP Quality Assurance Program Plan.
3. City of West Sacramento. 2010. Sacramento River Watershed Sanitary Survey 2010 Update.
Available at:
<https://www.cityofwestsacramento.org/civica/filebank/blobdload.asp?BlobID=6569>
4. State Water Resource Control Board. 2010. Procedures Manual for Water Quality Monitoring by the Ag and Surface Water Assessment Unit.

DRAFT

ATTACHMENT 1: SITE PHOTOS

A1: Sacramento River Basin Sites

520CBDKLU—Colusa Basin Drain above Knights Landing
520CRCOOH—Sutter Bypass downstream of Obanion Outfall
520YOL001—Sacramento River at Rough and Ready Pumping Plant
519SACVER—Sacramento River below Verona

A2: San Joaquin River Basin Sites

541MER531—Salt Slough at Lander Avenue
541XSSASD—Salt Slough at Sand Dam
541MER050—Boundary Drain at SLCC Sampling Station
535STC501—San Joaquin River at Crows Landing
541SJC501—Turlock Irrigation District (TID) Lateral #5
541SJC501—San Joaquin River at Airport Way near Vernalis
541STC516—Del Puerto Creek at Vineyard Road

A1: Sacramento River Basin—Colusa Basin Drain above Knights Landing (520CBDKLU)



A1: Sutter Bypass downstream of Obanion Outfall (520CRCOOH)



A1: Sacramento River at Rough and Ready Pumping Plant (520YOL001)



A1: Sacramento River below Verona (519SACVER)



A2: San Joaquin River Basin—Salt Slough at Lander Avenue (541MER531)



A2: Salt Slough at Sand Dam (541XSSASD)



A2: Boundary Drain at SLCC Sampling Station (541MER050)



A2: San Joaquin River at Crows Landing (535STC504)



A2: TID Lateral #5 (535STC501)



A2: San Joaquin River at Airport Way near Vernalis (541SJC501)



A2: Del Puerto Creek at Vineyard Road (541STC516)



Upstream



Between Banks



Downstream

ATTACHMENT 2: PARAMETERS AND CRITERIA

Analyte	Primary MCL or other Evaluation Criteria	Secondary MCL	California Toxics Rule (CTR)
1,1,1-Trichloroethane	0.200 mg/L		
1,1,2,2-Tetrachloroethane	0.001 mg/L		0.00017 mg/L
1,1,2,2-Trichloroethane			0.00060 mg/L
1,1,2,Trichloro-1,2,2-Trifluoroethane	1.2 mg/L		
1,1,2-Trichloroethane	0.005 mg/L		
1,1-Dichloroethane	0.005 mg/L		
1,1-Dichloroethylene	0.006 mg/L		0.000057 mg/L
1,2 Dichlorobenzene			2.7 mg/L
1,2,4-Trichlorobenzene	0.005 mg/L		
1,2-Dibromo-3chloroproppane (DBCP)	0.0017 µg/L [CA Public Health Goal OEHHA]		
1,2-Dichlorobenzene	0.6 mg/L		
1,2-Dichloroethane	0.005 mg/L		0.00038 mg/L
1,2-Dichloropropane	0.005 mg/L		0.00052 mg/L
1,2-Diphenylhydrazine			0.000040 mg/L
1,2-Trans-Dichloroethylene			0.700 mg/L
1,3 Dichlorobenzene			0.400 mg/L
1,3-Dichloropropene	0.0005 mg/L		
1,3-Dichloropropylene			0.010 mg/L
1,4 Dichlorobenzene			0.400 mg/L
1,4-Dichlorobenzene	0.005 mg/L		
2,3,7,8-TCDD (Dioxin)	3 x 10-8 mg/L		
2,4,5-TP (Silvex)	0.05 mg/L		
2,4,6-Trichlorophenol			0.0021 mg/L
2,4-D	0.07 mg/L		
2,4-Dichlorophenol			0.093 mg/L
2,4-Dimethylphenol			0.540 mg/L
2,4-Dinitrophenol			0.070 mg/L
2,4-Dinitrotoluene			0.00011 mg/L
2-Chloronaphthalene			1.7 mg/L
2-Chlorophenol			0.120 mg/L
2-Methyl-4,6-Dinitrophenol			0.0134 mg/L
3,3'-Dichlorobenzidine			0.00004 mg/L
4,4'-DDD			0.00000059 mg/L
4,4'-DDE			0.00000083 mg/L

Analyte	Primary MCL or other Evaluation Criteria	Secondary MCL	California Toxics Rule (CTR)
4,4'-DDT			0.00000059 mg/L
Acenaphthene			1.2 mg/L
Acrolein			0.320 mg/L
Acrylonitrile			0.000059 mg/L
Alachlor	0.002 mg/L		
Aldrin			0.00000013 mg/L
Alpha-BHC			0.0000039 mg/L
Alpha-Endosulfan			0.110 mg/L
Anthracene			9.6 mg/L
Antimony	0.006 mg/L		.0014 mg/L
Atrazine	0.001 mg/L		
Barium	1.0 mg/L		
Bentazon	0.018 mg/L		
Benzene	0.001 mg/L		0.0012 mg/L
Benzidine			0.00000012 mg/L
Benzo(a)Anthracene [1,2-Benzanthracene]			0.0000044 mg/L
Benzo(a)pyrene	0.0002 mg/L		
Benzo(a)Pyrene			0.0000044 mg/L
Benzo(b)Fluoranthene [3,4-Benzofluoranthene]			0.0000044 mg/L
Benzo(k)Fluoranthene			0.0000044 mg/L
Beryllium	0.004 mg/L		
Beta/photon emitters	4 millirem/year annual dose equivalent to the total body or any internal organ		
Beta-BHC [beta-Hexachlorocyclohexane]			0.000014 mg/L
Beta-Endosulfan			0.110 mg/L
Bis(2-Chloroethyl)Ether			0.000031 mg/L
Bis(2-Chloroisopropyl)Ether			1.400 mg/L
Bis(2-Ethylhexyl)Phthalate			0.0018 mg/L
Boron	1 mg/L [CA DPH Notification Level for drinking water]		
Bromoform			0.0043 mg/L
Butylbenzyl Phthalate			3.0 mg/L
Carbofuran	0.018 mg/L		
Carbon Tetrachloride	0.0005 mg/L		0.00025 mg/L
Chlordane	0.0001 mg/L		
Chlordane			0.00000057 mg/L

Analyte	Primary MCL or other Evaluation Criteria	Secondary MCL	California Toxics Rule (CTR)
Chloride		250 mg/L	
Chlorobenzene			0.680 mg/L
Chlorodibromomethane			0.000401 mg/L
Chloroform	1.1 µg/L [Cal/EPA Cancer Potency Factor as a drinking water level (b)]		
Chlorpyrifos	2 µg/L [USEPA, OPP Drinking Water Health Advisory - non-cancer]		
Chrysene			0.0000044 mg/L
Cis1,2-Dichloroethylene	0.006 mg/L		
Color		15 Units	
Cyanide	0.15 mg/L		0.700 mg/L
Dalapon	0.2 mg/L		
Di(2-ethylhexyl)adipate	0.4 mg/L		
Di(2-ethylhexyl)phthalate (DEHP)	0.004 mg/L		
Diazinon	1.2 µg/L [CA DPH Notification Level for drinking water]		
Dibenzo(ah)Anthracene			0.0000044 mg/L
Dibromochloropropane (DBCP)	0.0002 mg/L		
Dichlorobromomethane			0.00056 mg/L
Dichloromethane	0.005 mg/L		
Dieldrin			0.00000014 mg/L
Diethyl Phthalate			23 mg/L
Dimethyl Phthalate			313 mg/L
Di-n-Butyl Phthalate			2.7 mg/L
Dinoseb	0.007 mg/L		
Diquat	0.02 mg/L		
<i>E. coli</i>	235 MPN/100 mL [USEPA Recreational Guideline]		
Endosulfan Sulfate			0.110 mg/L
Endothall	0.1 mg/L		
Endrin	0.002 mg/L		0.00076 mg/L
Endrin Aldehyde			0.00076 mg/L
Ethylbenzene	0.3 mg/L		3.100 mg/L
Ethylene Dibromide	0.00005 mg/L		
Fluoranthene			0.3 mg/L
Fluorene			1.3 mg/L
Fluoride	2.0 mg/L		
Foaming Agents (MBAS)		0.5 mg/L	
Gamma-BHC [Lindane]			0.000019 mg/L

Analyte	Primary MCL or other Evaluation Criteria	Secondary MCL	California Toxics Rule (CTR)
Glyphosphate	0.7 mg/L		
Gross Alpha particle activity (excluding radon and uranium)	15 pCi/L		
Heptachlor	0.00001 mg/L		0.00000021 mg/L
Heptachlor Epoxide	0.00001 mg/L		0.00000010 mg/L
Hexachlorobenzene	0.001 mg/L		0.00000075 mg/L
Hexachlorobutadiene			0.00044 mg/L
Hexachlorocyclopentadiene	0.05 mg/L		
Hexachlorocyclopentadiene			0.240 mg/L
Hexachloroethane			0.0019 mg/L
Indeno(1,2,3-cd) Pyrene			0.0000044 mg/L
Isophorone			0.0084 mg/L
Lindane	0.0002 mg/L		
Mercury	0.002 mg/L		0.000050 mg/L
Methoxychlor	0.03 mg/L		
Methyl Bromide (Bromomethane)			0.048 mg/L
Methylene Chloride (Dichloromethane)			0.0047 mg/L
Methyl-tert-butyl ether	0.013 mg/L	0.005 mg/L	
Molinate	0.02 mg/L		
Monochlorobenzene	0.07 mg/L		
Nitrate (as NO ₃)	45 mg/L		
Nitrate+Nitrite (sum as nitrogen)	10 mg/L		
Nitrite (as Nitrogen)	1.0 mg/L		
Nitrobenzene			0.017 mg/L
N-Nitrosodimethylamine			0.00000069 mg/L
N-Nitrosodi-n-Propylamine			0.000005 mg/L
N-Nitrosodiphenylamine			0.005 mg/L
Odor		Threshold 3 Units	
Oxamyl	0.05 mg/L		
Pentachlorophenol	0.001 mg/L		0.00028 mg/L
Pentachlorophenol	0.001 mg/L		0.00028 mg/L
Perchlorate	0.006 mg/L		
pH	6.5 - 8.5 [USEPA Secondary MCL]		
Phenol			21.0 mg/L
Picloram	0.5 mg/L		
Polychlorinated Biphenyls	0.0005 mg/L		0.00000017 mg/L

Analyte	Primary MCL or other Evaluation Criteria	Secondary MCL	California Toxics Rule (CTR)
Pyrene			0.960 mg/L
Radium-226	5 pCi/L (combined radium-226 & -228)		
Radium-228	5 pCi/L (combined radium-226 & -228)		
Simazine	0.004 mg/L		
Sodium	20 mg/L [USEPA Drinking Water Advisory]		
Specific Conductance		900 μ S/cm	
Strontium-90	8 pCi/L (=4 millirem/yr dose to bone marrow)		
Styrene	0.1 mg/L		
Sulfate		250 mg/L	
Tetrachloroethylene	0.005 mg/L		0.0008 mg/L
Thallium	0.002 mg/L		.0017 mg/L
Thiobencarb	0.07 mg/L	0.001 mg/L	
Toluene	0.15 mg/L		6.800 mg/L
Total Aluminum	1.0 mg/L	0.2 mg/L	
Total Ammonia	1.5 mg/L [Odor threshold (Amoore and Hautala)]		
Total Arsenic	0.010 mg/L		
Total Cadmium	0.005 mg/L		
Total Chromium	0.05 mg/L		
Total Copper		1.0 mg/L	1.300 mg/L
Total Dissolved Solids		500 mg/L	
Total Iron		0.3 mg/L	
Total Lead	0.2 μ g/L [CA Public Health Goal OEHHA]		
Total Manganese		0.05 mg/L	
Total Nickel	0.1 mg/L		0.610 mg/L
Total Selenium	0.05 mg/L		
Total Silver		0.1 mg/L	
Total Triahalomethanes	0.080 mg/L		
Total Zinc		5.0 mg/L	
Toxaphene	0.003 mg/L		0.00000073 mg/L
Trans-1,2-Dichloroethylene	0.01 mg/L		
Trichlorofluoromethane	0.15 mg/L		
Turbidity		5 NTU [§64653.Filtration - CDPH]	
Vinyl Chloride	0.0005 mg/L		0.002 mg/L
Xylenes	1.750 mg/L		